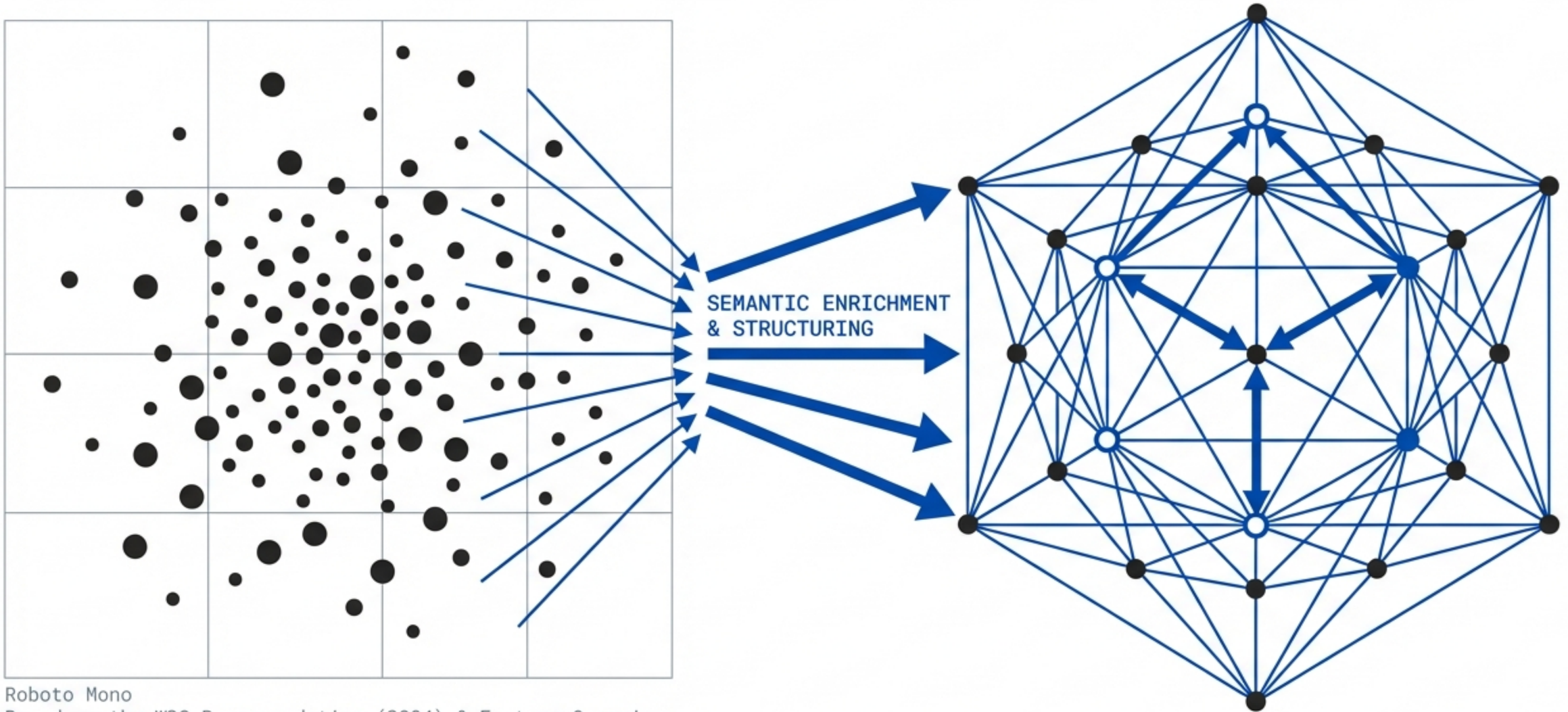
OWL: The Web Ontology Language

Moving from Machine-Readable to Machine-Understandable



Roboto Mono
Based on the W3C Recommendation (2004) & Feature Overview

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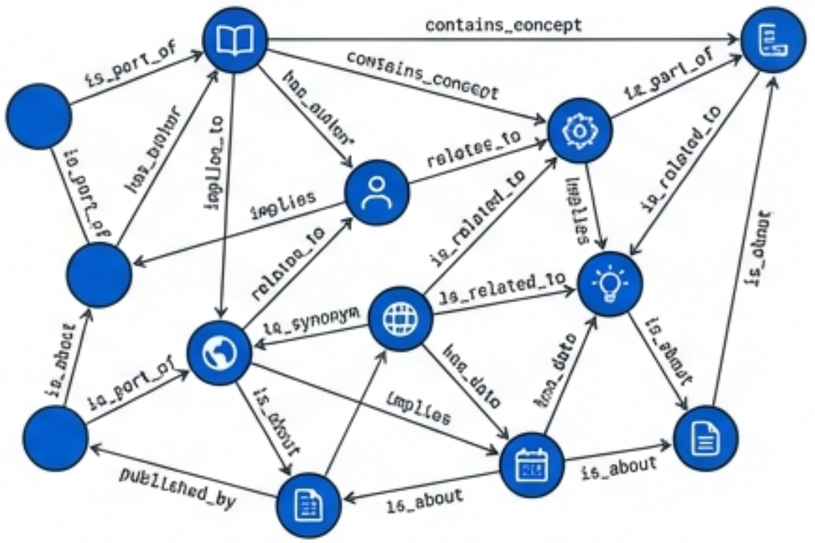
The Semantic Vision
Processing Content vs. Presenting Information

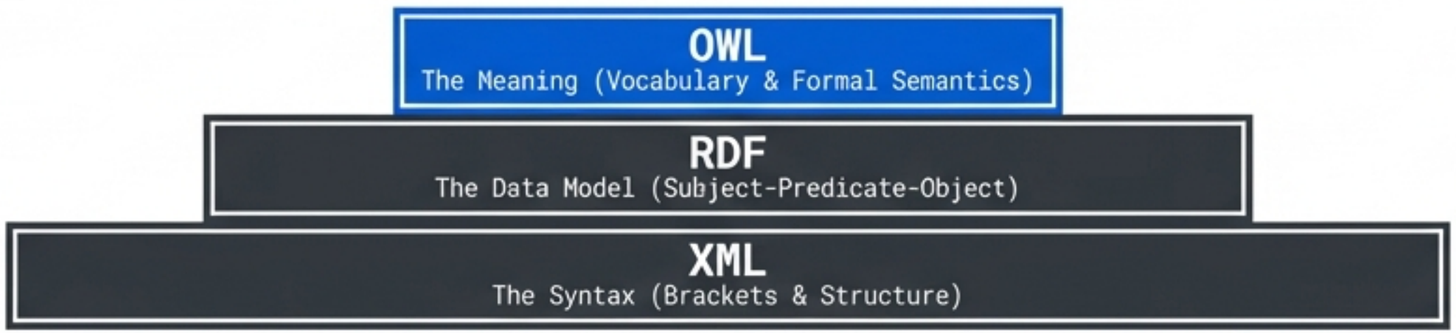
The Old Way

Presentation (Human Eyes Only).

The Semantic Way



Processing (Machine Understandable).



"OWL facilitates greater machine interpretability than XML, RDF, and RDF-S."

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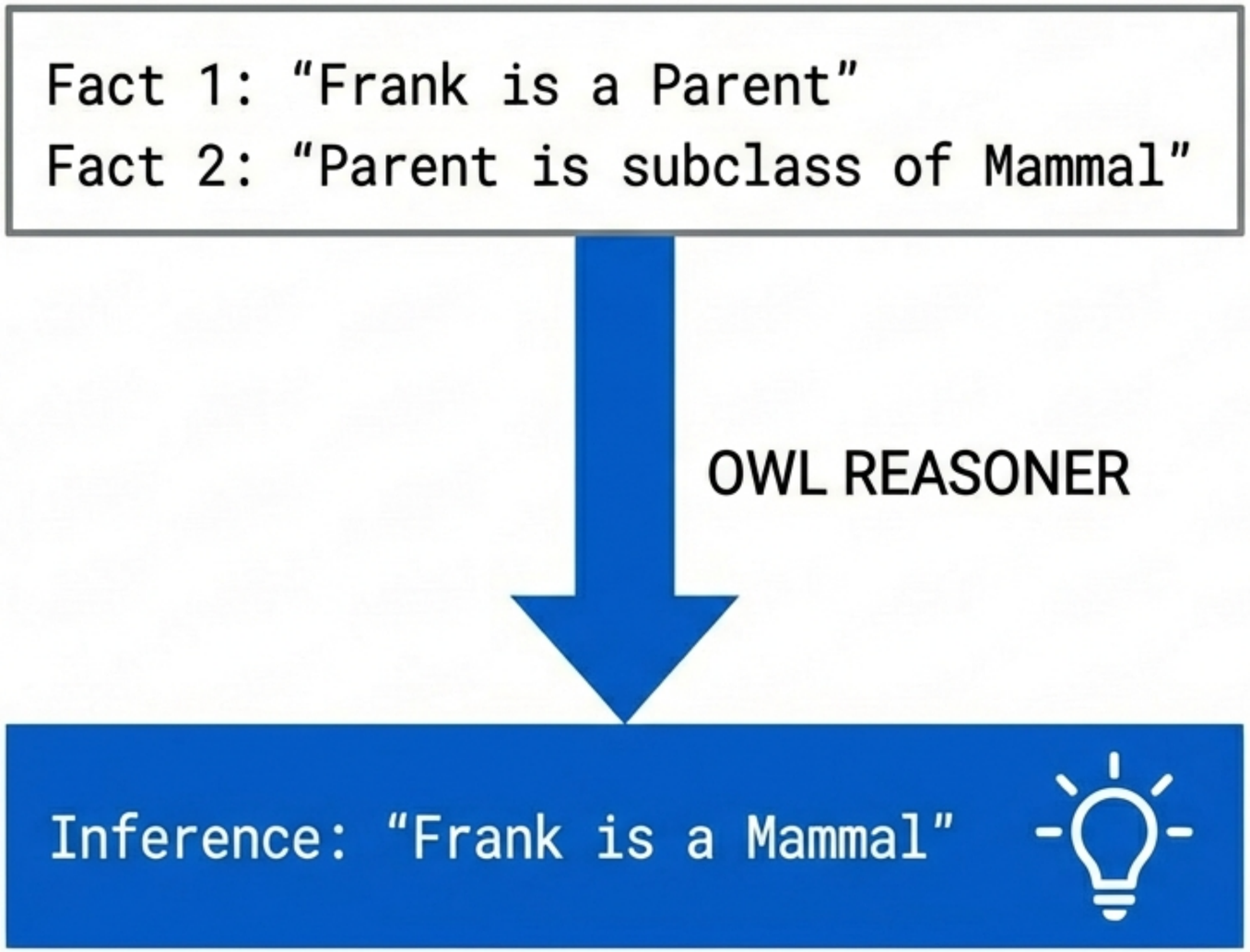
The Power of Inference

Creating new knowledge without new input.



Explicit Meaning allows machines to deduce facts that were never typed in.

Unlike a database that only knows what acts are explicitly stored, OWL defines the rules that allow software agents to derive consequences automatically.

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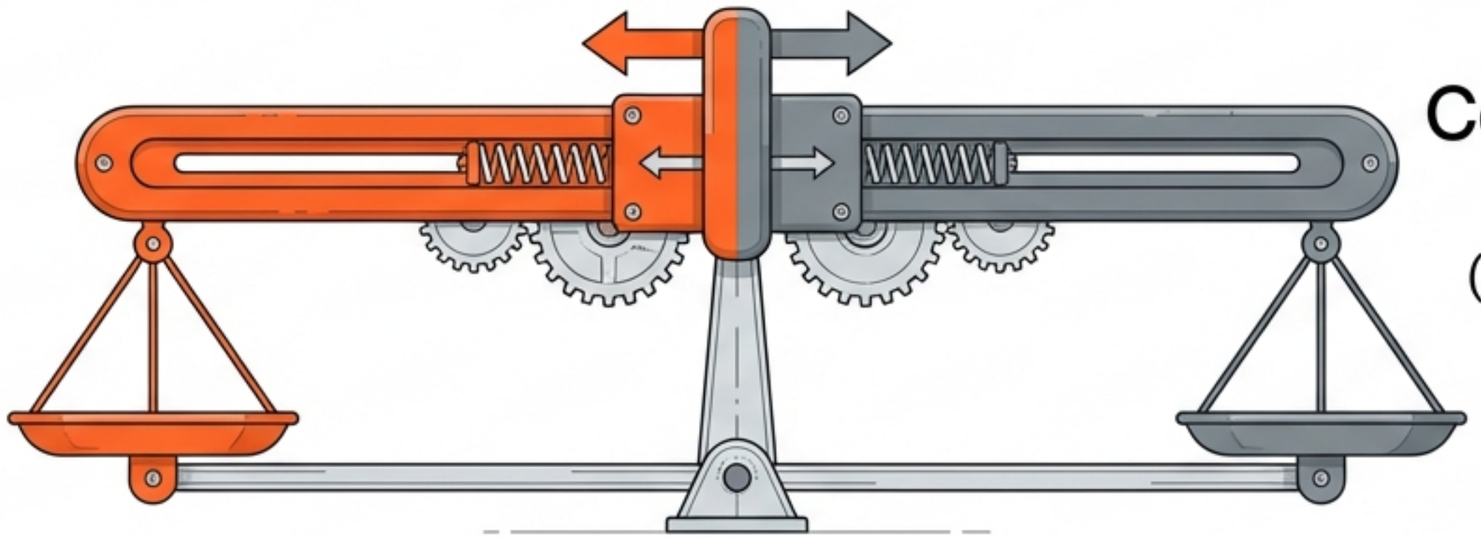
The Core Tension
Expressiveness vs. Computability

Expressive Power
(What you can say)



Computational Guarantee
(Can the machine process it?)

A language that allows you to say *anything* creates reasoning tasks that might never finish.

The Trade-off: To guarantee the computer can provide an answer in finite time (decidability), we must sometimes limit the complexity of our descriptions.

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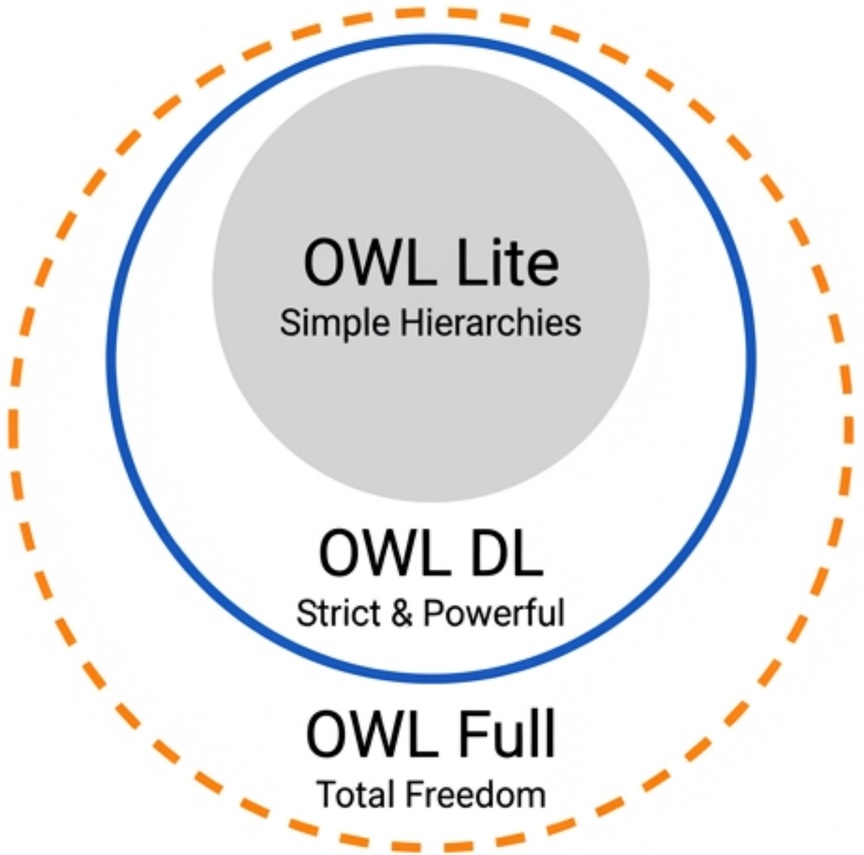
The Ecosystem

Three sublanguages. A flavor for every need.



`OWL Lite ⊂ OWL DL ⊂ OWL Full`

Every legal OWL Lite ontology is valid OWL DL. Every legal OWL DL ontology is valid OWL Full. The inverse does not hold.

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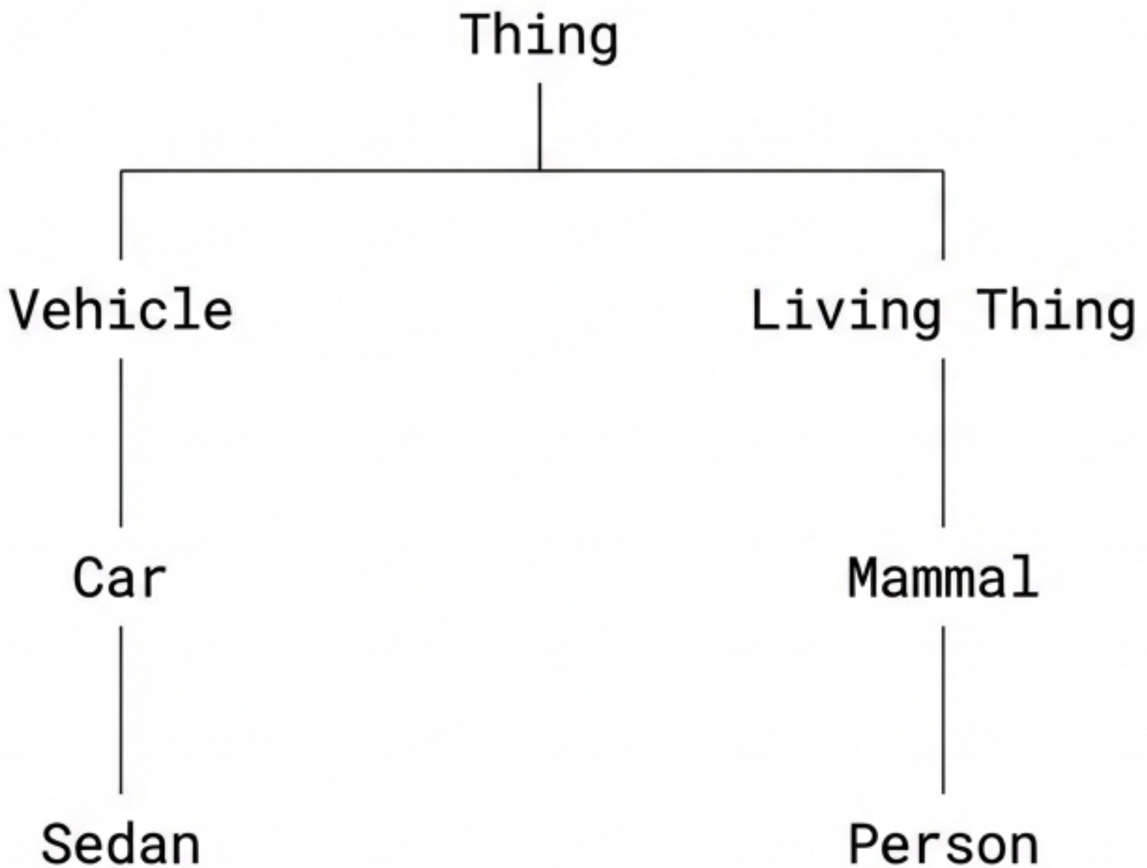
OWL Lite: The Foundation

Users needing simple taxonomies and classification.



Key Constraints

Cardinality is Binary. Restricted to values of 0 or 1 only.

- ☒ Required (Min 1)
- ☒ Required (Min 1)
- ☒ Optional (Min 0)
- ☒ Unique (Max 1)
- ☐ “Exactly 5 wheels” (Forbidden)

Use Case: Quick migration for existing thesauri

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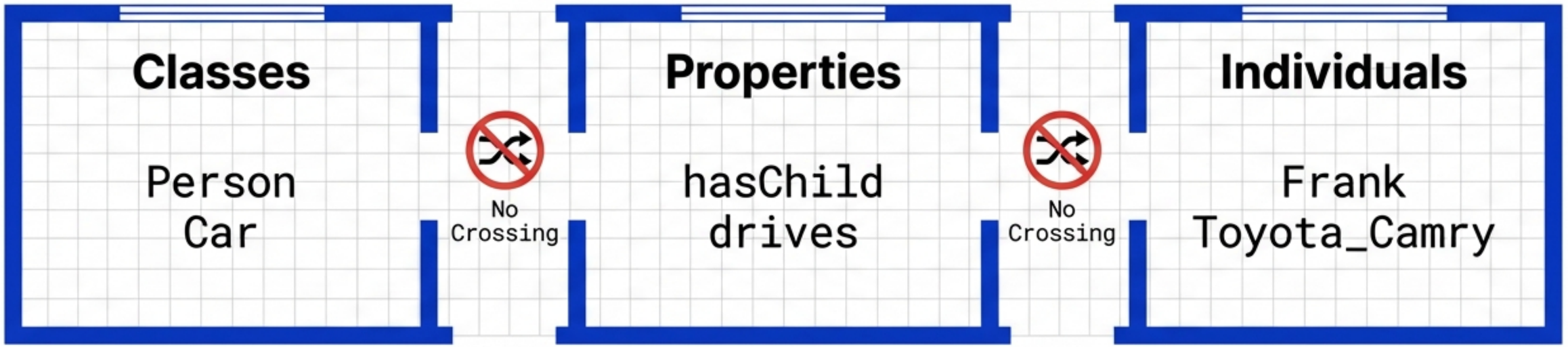
OWL DL (Description Logic)

The Computational Sweet Spot.



The Promise:

Computational Completeness & Decidability. Propertics s uncosnoirs & Decidability.
All conclusions are computable in finite time.

The Rule:

Type Separation. A Class cannot be an Individual. A Property cannot be a Class.
This strict separation keeps the logic clean.

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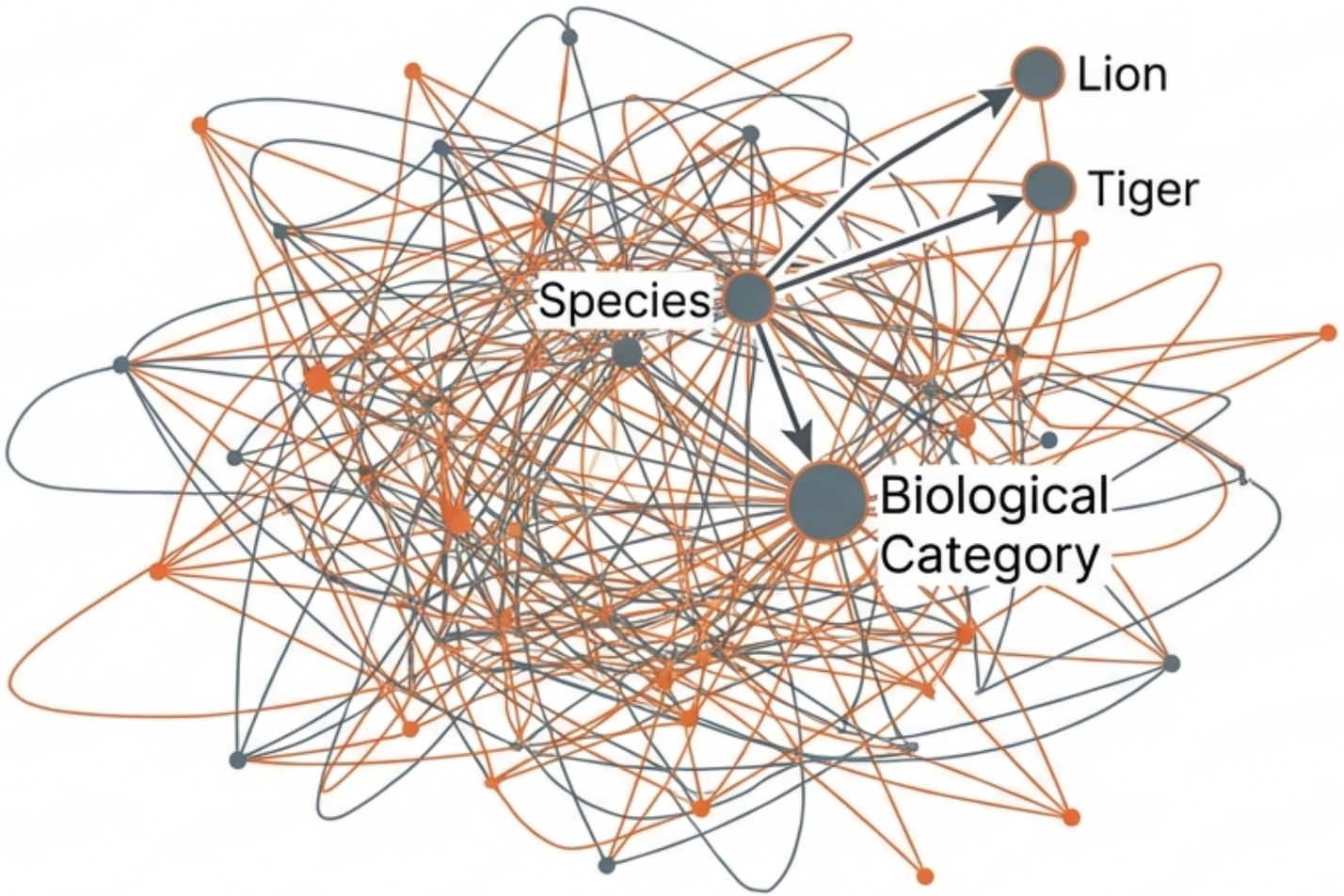
OWL Full: The Wild West

Maximum Expressiveness. No Guarantees.



Key Feature: Meta-modeling.

A Class can be treated as an Individual.

The Warning:

Reasoning tools may never finish computing. This level offers the syntactic freedom of RDF with no computational safety net.

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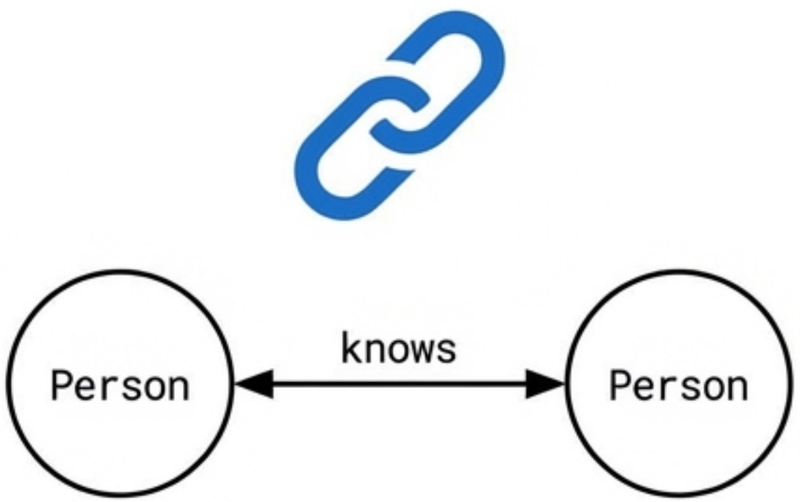
Building Blocks

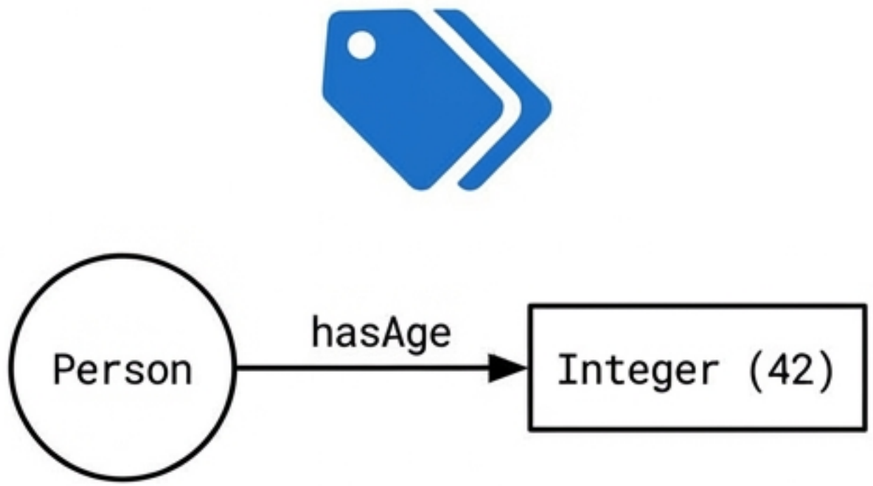
The Atomic Units of OWL

ObjectProperty



Relates two individuals.

DatatypeProperty



Relates an individual to a data value.

Context Control: `rdfs:domain` limits where a property applies. `rdfs:range` limits the value type.

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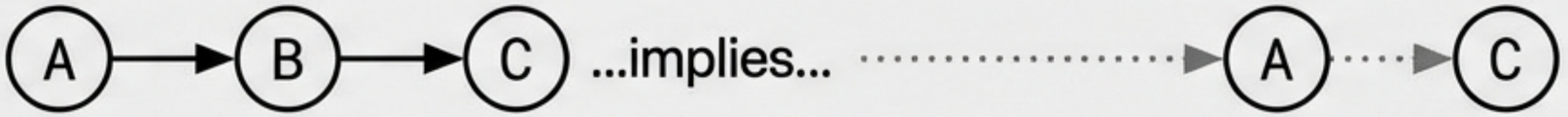
Property Characteristics

Defining the Physics of Relationships.

Ancestor	
Friend	
Parent <-> Child	
Biological Mother	

These definitions allow the reasoner to automatically fill in the blanks in the knowledge graph.

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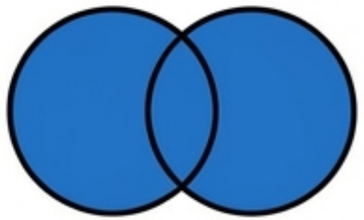
Logic & Sets (DL / Full)

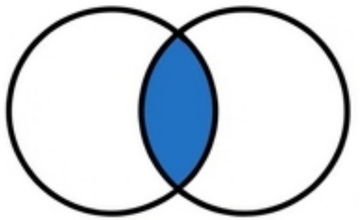
Creating complex definitions from simple parts.

UnionOf



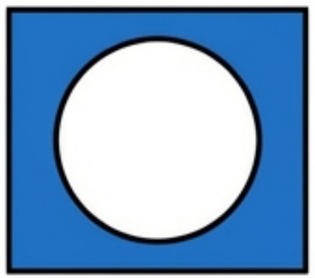
(US Citizen OR Dutch Citizen)

IntersectionOf



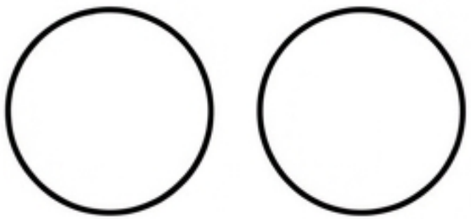
(Employee AND Person)

ComplementOf



(NOT Senior Citizen)

DisjointWith



(Man vs. Woman)

In OWL DL and OWL Full, these operations can be combined to form arbitrary complex class descriptions.

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Constraints & Cardinality

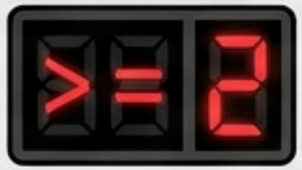
Defining Limits and Precision.

Cardinality Counters

Lite

Cardinality Counters

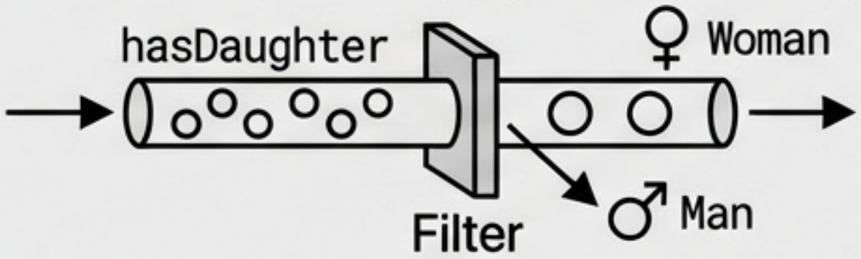
DL/Full



Class: DINKs (Dual Income, No Kids).
Income >= 2, Kids = 0.

Restrictions

allValuesFrom (Type Constraint)



Only ‘Woman’ nodes can pass through the ‘hasDaughter’ pipe.

Restrictions

someValuesFrom (Existence Constraint)

Must have at least one.

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Identity Management

The Unique Name Assumption (does not exist on the web).

- **`sameAs`**: Links different URIs to one entity.
- **`differentFrom`**: Explicitly separates “Frank” != “Deborah”.
- **`AllDifferent`**: A distinct list (e.g., Planets).
- **`InverseFunctionalProperty`**: Like a Social Security Number—a unique key that proves identity.

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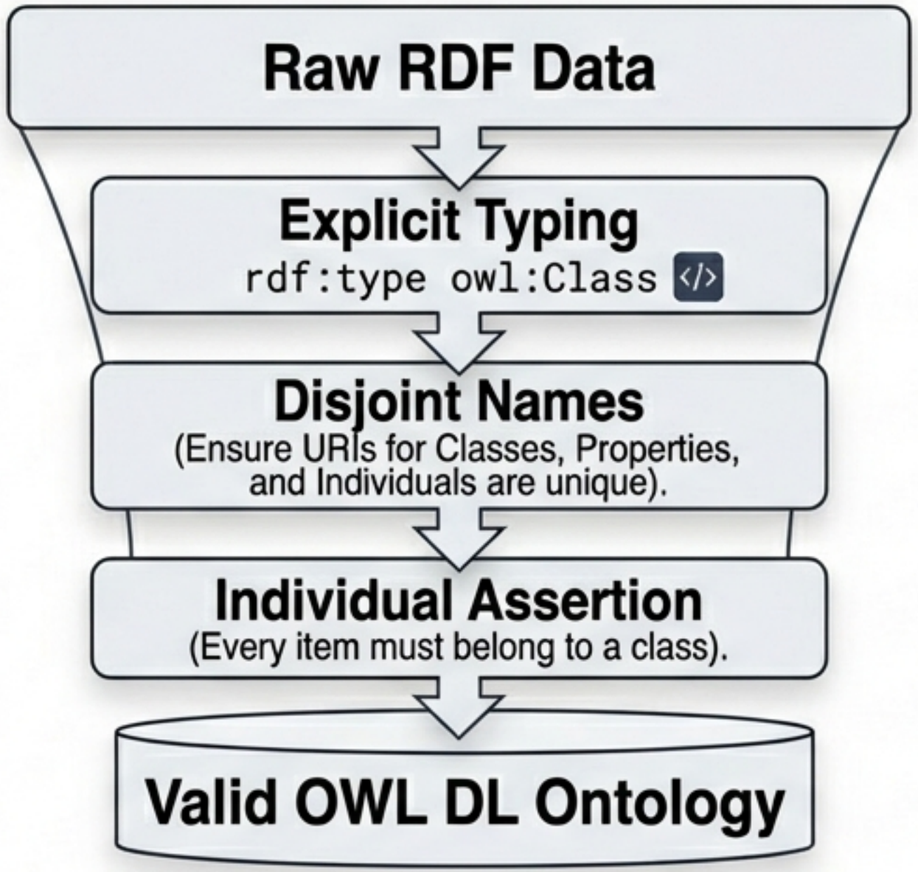
From RDF to OWL DL

A Practical Migration Checklist.



Every OWL document is RDF, but not every RDF document is valid OWL DL.

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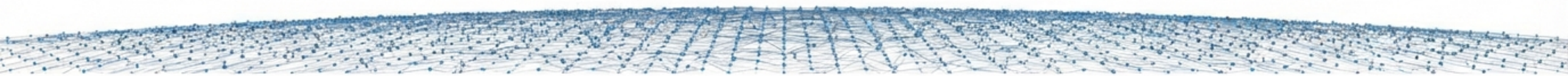
Structuring the World's Knowledge

Conclusion



OWL transforms the web from a collection of documents into a global database of linked, understandable concepts.

It gives explicit meaning to information, making it easier for machines to automatically process and integrate.

Note: OWL 2 (2009) extends these foundations while maintaining compatibility.

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